ME 3023   Challenge 3 – Sensor Calibration

Learning Objectives

Students will practice skills with a digital multimeter to collect data from a 2014 Chevrolet corvette acceleration pedal sensor (GM 23418313). The data will be used to generate a calibration curve.

1. apply the concepts and definitions of calibration, static sensitivity and zero offset for an analog sensor

2. determine appropriate statements of uncertainty for multimeter measurements

3. operate laboratory multimeter and wiring diagram to inspect and record position sensor signal output

4. construct circuit and operate laboratory power supply to power sensor

Background
Consult the user manuals for the multimeter. A wiring diagram for a similar sensor is provided. The pinout for the connector is also provided.

Collaboration
This challenge can be accomplished as an individual or as a group of two.

Setup Notes
The accelerator pedal position unit contains two separate sensors in a single package (APP1, APP2). This challenge will only require wiring the first sensor (APP1) to the breadboard. The remaining three wires are for the second sensor and will not be used in this challenge.

Activity 1 – Construct circuit

Connect the sensor wires to the breadboard posts as shown in the image. Use the banana plug wires to connect the power supply to the breadboard. Make sure to connect ground (0v) to pin A and 5v to pin C. The sensor signal will be measured with the multimeter from pin B with respect to ground.

With the power supply turned off and the pedal not depressed, measure the resistance between pin B and pin A while the pedal is not depressed. Depress the pedal and measure the resistance between pin B and pin A again.

Activity 2 - Use multimeter to collect static calibration data
To generate data for the calibration process, collect voltage measurements from the output signal corresponding to a range of known input. ASME test standard XYZ describes collecting a series of static calibration data points as the independent variable or reference in increased through the intended operating range and repeating the same measurements as the referenced is decreased.

Activity 3 – Generate Calibration Curve

Plot the collected calibration data with the known reference data on the x axis and the measured voltages from the sensor signal on the y axis. Show both sets of calibration data on the same figure.

Activity 4 –Determine Goodness of Fit

Observations and Discussion:

During Activity 2, Activity 3 and Activity 4, the digital multimeter was used to measure the output voltage response from a RC circuit subject to a step input voltage, and the expected analytical solution was also determined. Compare the results from both methods and discuss what was observed from the comparison, including what can be declared regarding uncertainty for each method. Does the physical RC circuit behave like the model predicts? Can the component parameters be used to characterize the system?